



# Southwest Fisheries Science Center

NOAA Fisheries Service



## Embracing an ecosystem approach to management: Real-life examples for cetaceans

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Lisa T. Ballance

*Protected Resources  
Division*

*NOAA Fisheries*

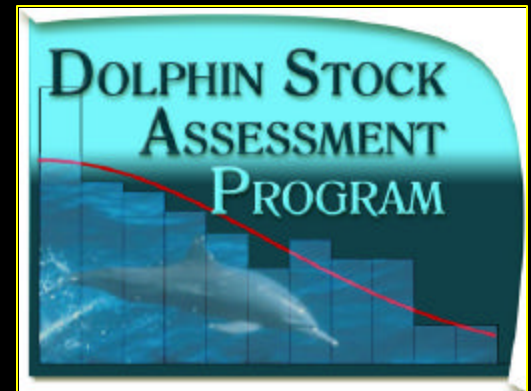
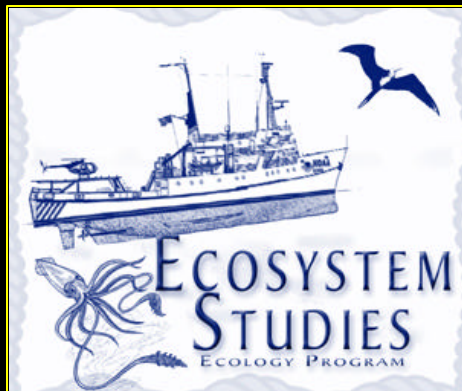
*La Jolla, CA*



# A collaborative effort

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Jay Barlow, Megan Ferguson, Paul Fiedler,  
Wayne Perryman, Robert Pitman, Jessica  
Redfern, Stephen Reilly, George Watters



# Mission: Protected Resources Division

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Monitor and assess the status of protected species in U.S. (EEZ) waters or regions where U.S. has a vested interest in order to provide a scientific basis for management advice



Mandates: ESA, MMPA, IDCPA





Central  
Pacific

2.4 million km<sup>2</sup>

California  
Current

1.1 million km<sup>2</sup>

High Seas

11 Foreign Nations

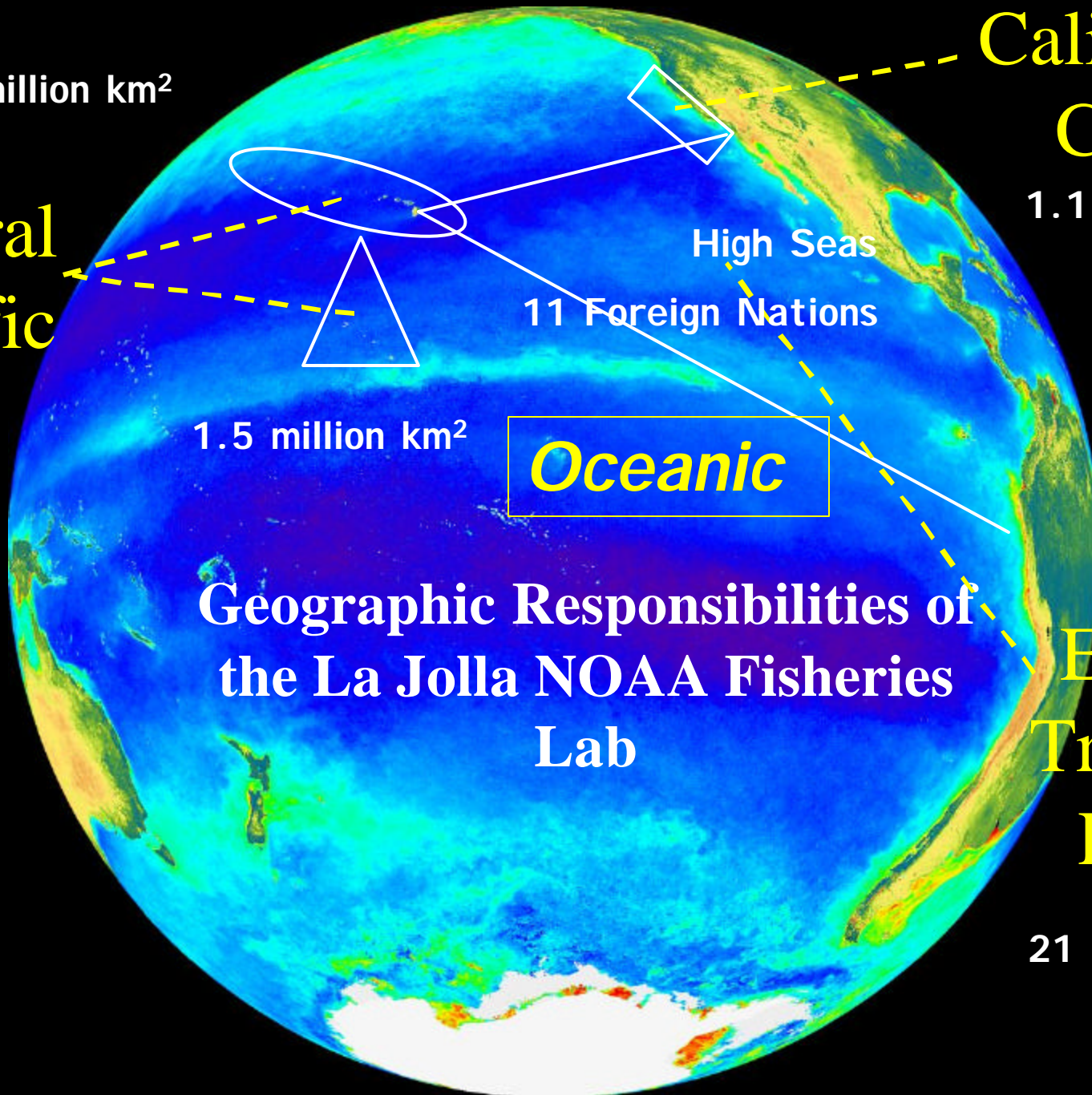
1.5 million km<sup>2</sup>

*Oceanic*

Geographic Responsibilities of  
the La Jolla NOAA Fisheries  
Lab

Eastern  
Tropical  
Pacific

21 million km<sup>2</sup>



# Monitoring through:

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- Aerial surveys
- Shore-based assessment
- Stranding network
- Fisheries observer programs



➤ Monitoring Through Assessment Cruises - cetaceans

# Cetacean and Ecosystem Assessment Cruises - 1986

## Ecosystem Assessment

### Cetacean Abundance

Abundance

School Size  
Calibration

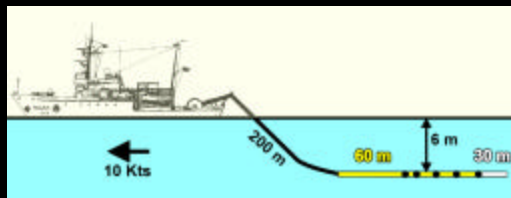
### Cetacean Biology

Population  
Structure

Behavior

Life  
History

Acoustics



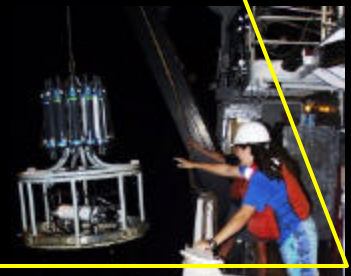
Apex  
Predators



Low- and Mid-  
Trophic Fishes and  
Invertebrates



Physical and Biological  
Habitat



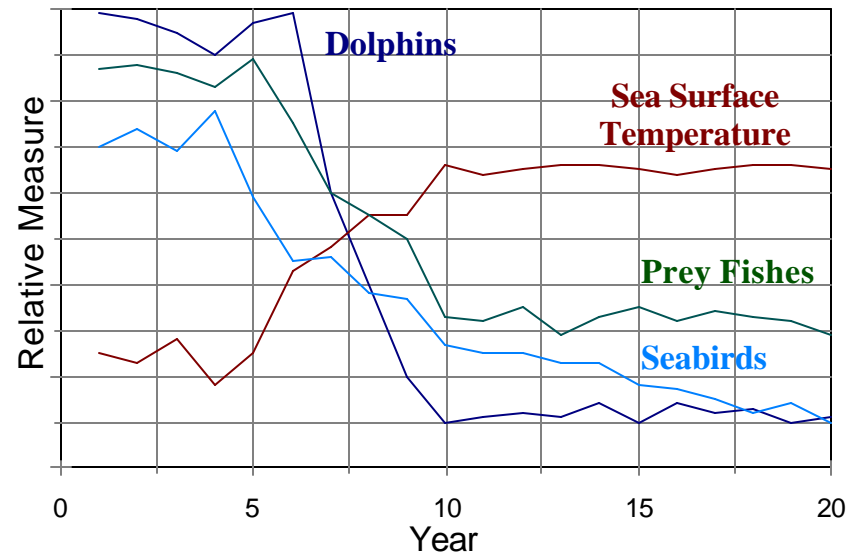
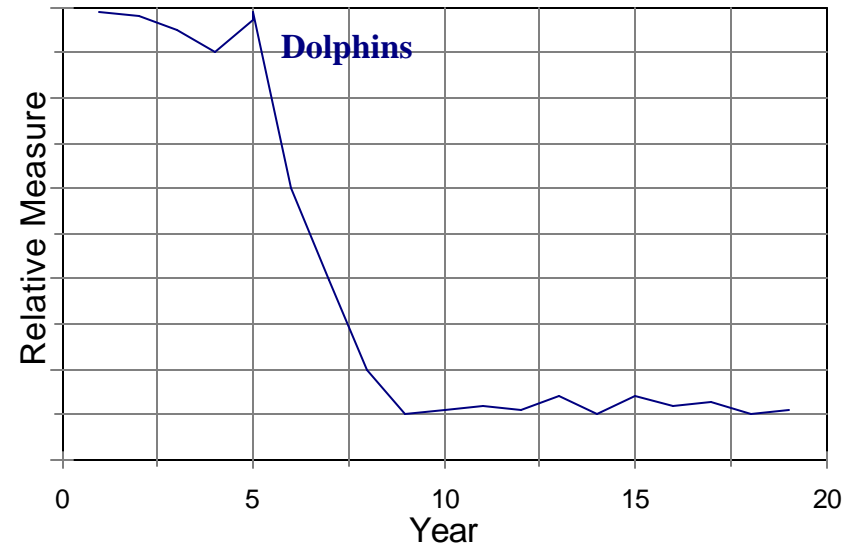


# ➤ Why ecosystem studies?



## Hypothetical Data

1. Provide Context for Interpretation
2. Allow for Prediction in Unsampled Areas, at Fine Resolution
3. Provide Data to Develop Ecosystem Approaches to Management





# Example 1: Ecosystem Studies Provide a Context for Interpretation

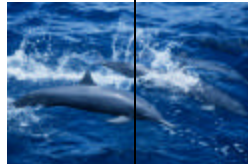
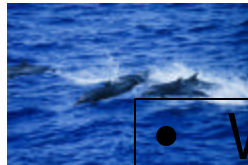
IDCPA Report to Congress, 2002

Reilly et al., 2005

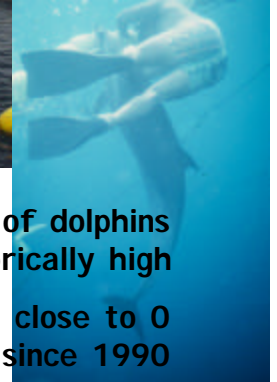
... and 7 ecosystem studies papers

# The Issue

In the ETP  
Spotted and  
Spinner dolphins  
school with BIG  
Yellowfin Tuna.  
Large, speciose  
flocks of birds  
feed over them  
and provide a  
VISUAL SIGNAL



Tuna fishers have learned to look for  
these visual signals as a way to catch  
lots of big fish.



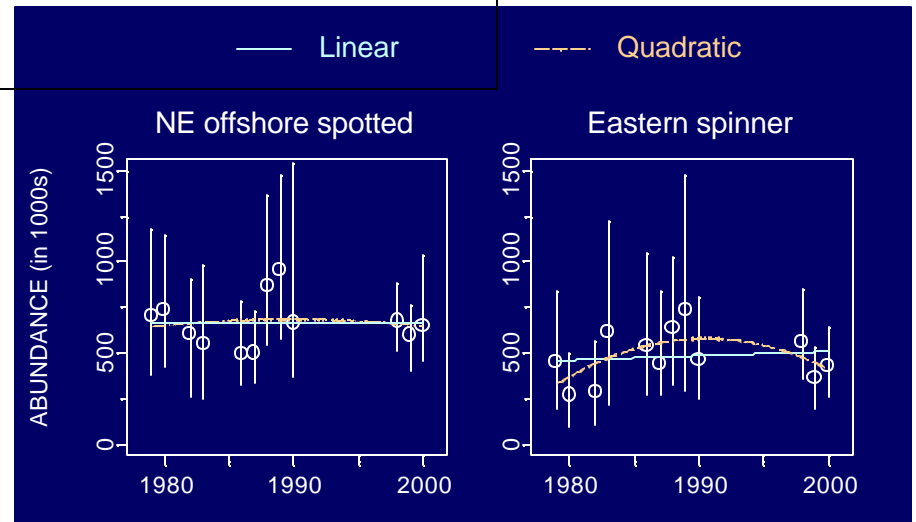
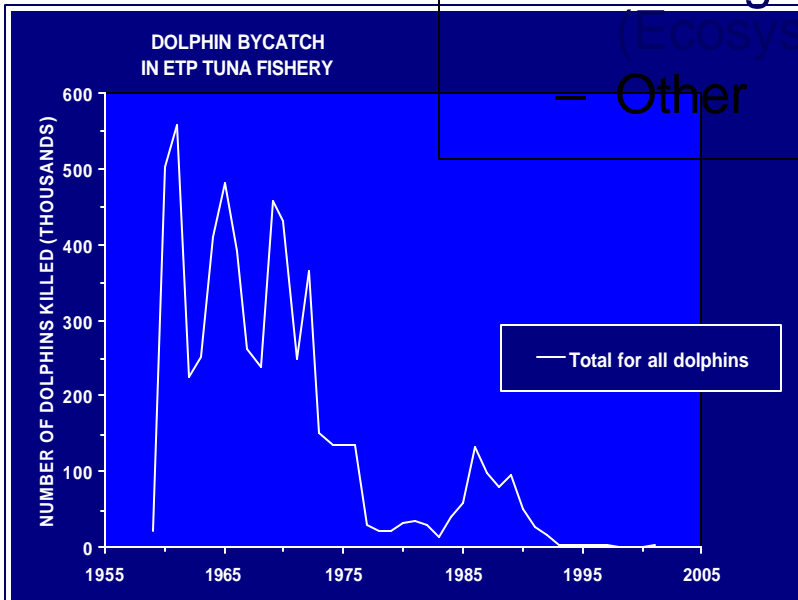
## • WHY?

- Time lag
- Fishery Effects
- Change in Carrying Capacity (Ecosystem Effects)
- Other

Incidental mortality of dolphins  
historically high

Observed mortality close to 0  
since 1990

Affected dolphins still  
depleted; no sign of recovery



# Has the E. tropical Pacific ecosystem changed, *and if so, could the change be of sufficient duration and magnitude to affect recovery of dolphin stocks?*

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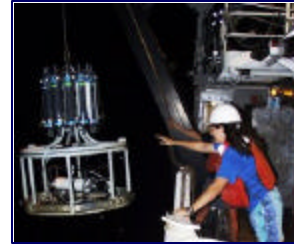
- Maximize number of habitat variables, trophic levels and taxa investigated

- Oceanography

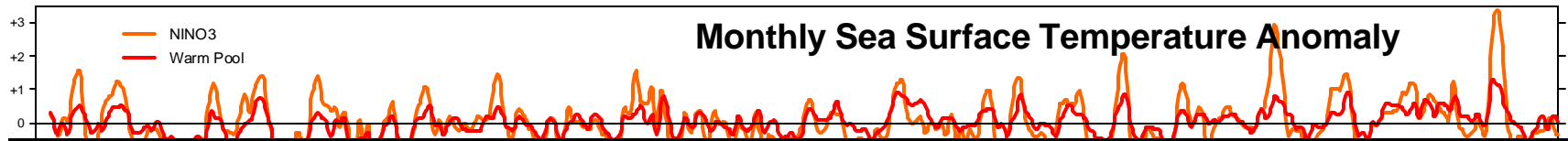
- Physical (5 variables) and Biological (2 variables)

- Biology

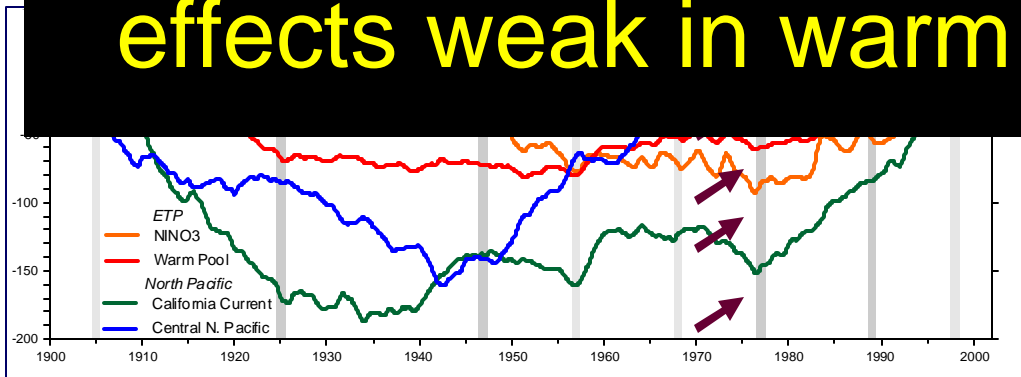
- Ichthyoplankton
  - Prey Fishes and Squids
    - 7 taxa: 4 fishes, 3 squids
  - Marine Turtles
  - Seabirds
    - 9 taxa: 5 tuna-dependent, 4 - independent
  - Cetaceans
    - 7 taxa: 2 target, 5 non-target



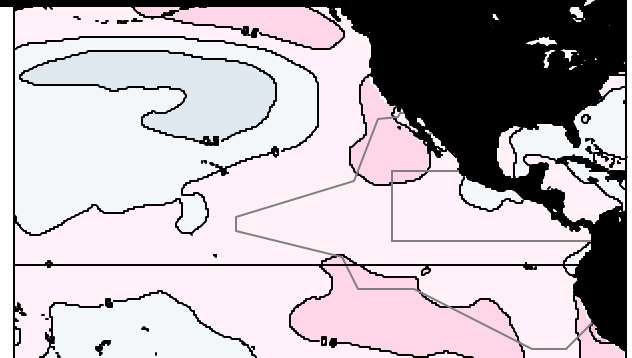
# Results - Oceanography



- Year to year variability with heavy influence by ENSO
- ENSO variability > Decadal variability
- Climate Shifts evident but physical effects weak in warm pool



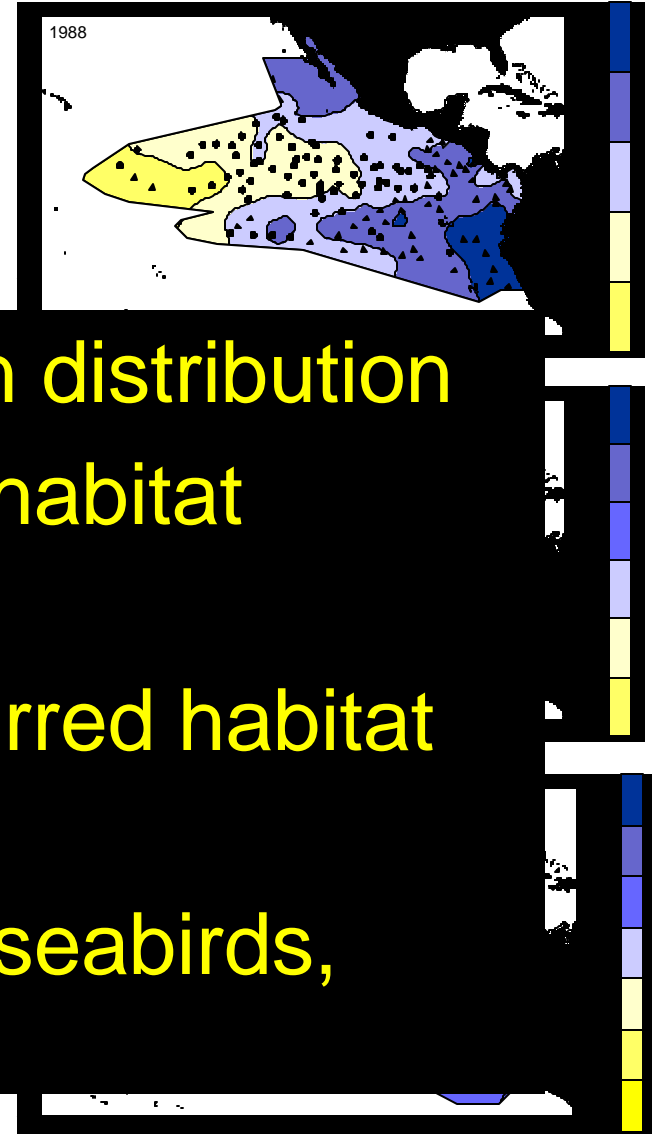
Decadal  
(1977-1988) - (1965-1976)





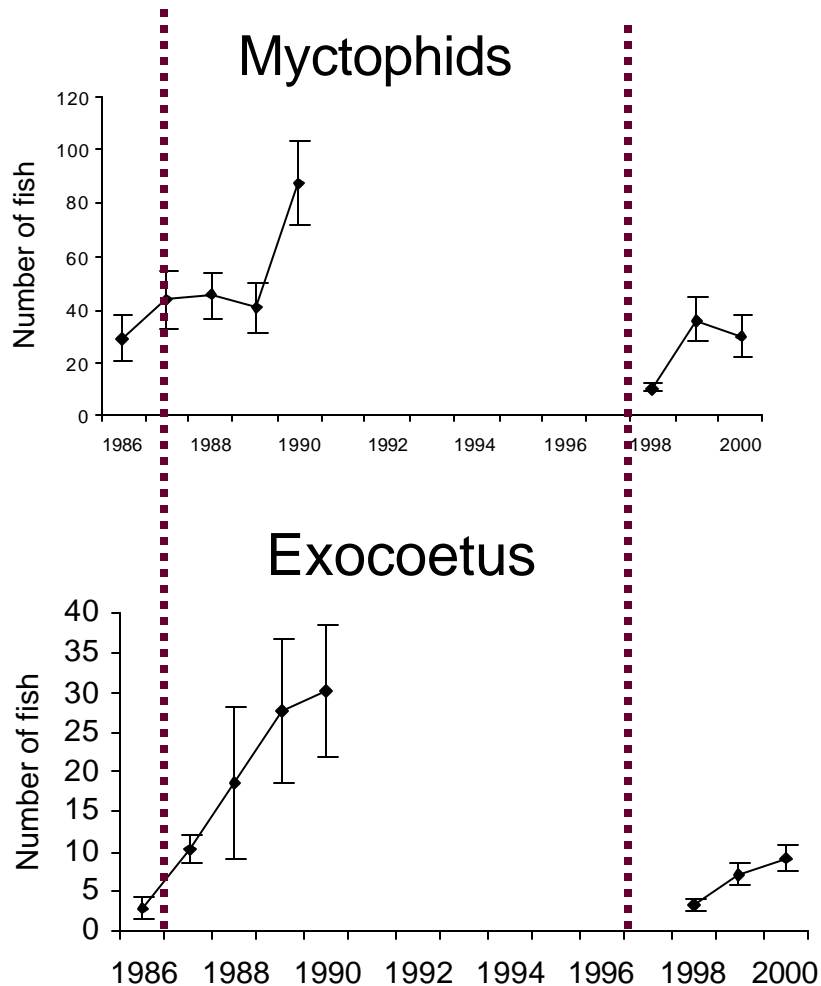
# Results – Distribution and Habitat Preferences

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- Year to year variability in distribution
- Species-/taxon-specific habitat preferences
- Species track their preferred habitat through time
- Prey fishes and squids, seabirds, cetaceans

# Results – Abundance

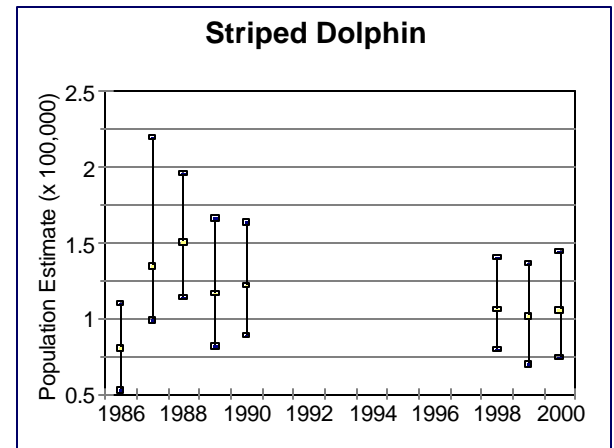
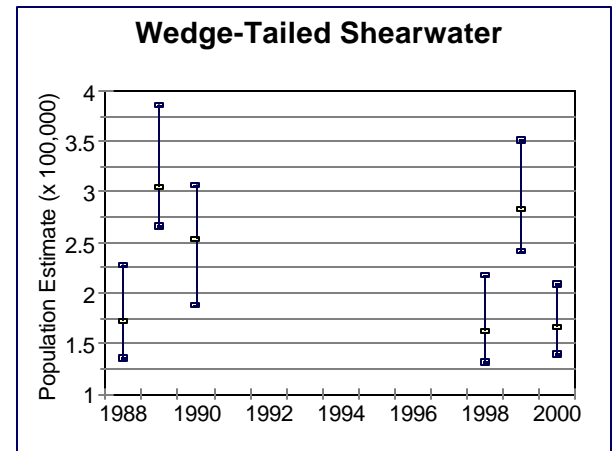


- Prey fishes and squids  
–r-selected

➤ Multi-year increase subsequent to El Niño events

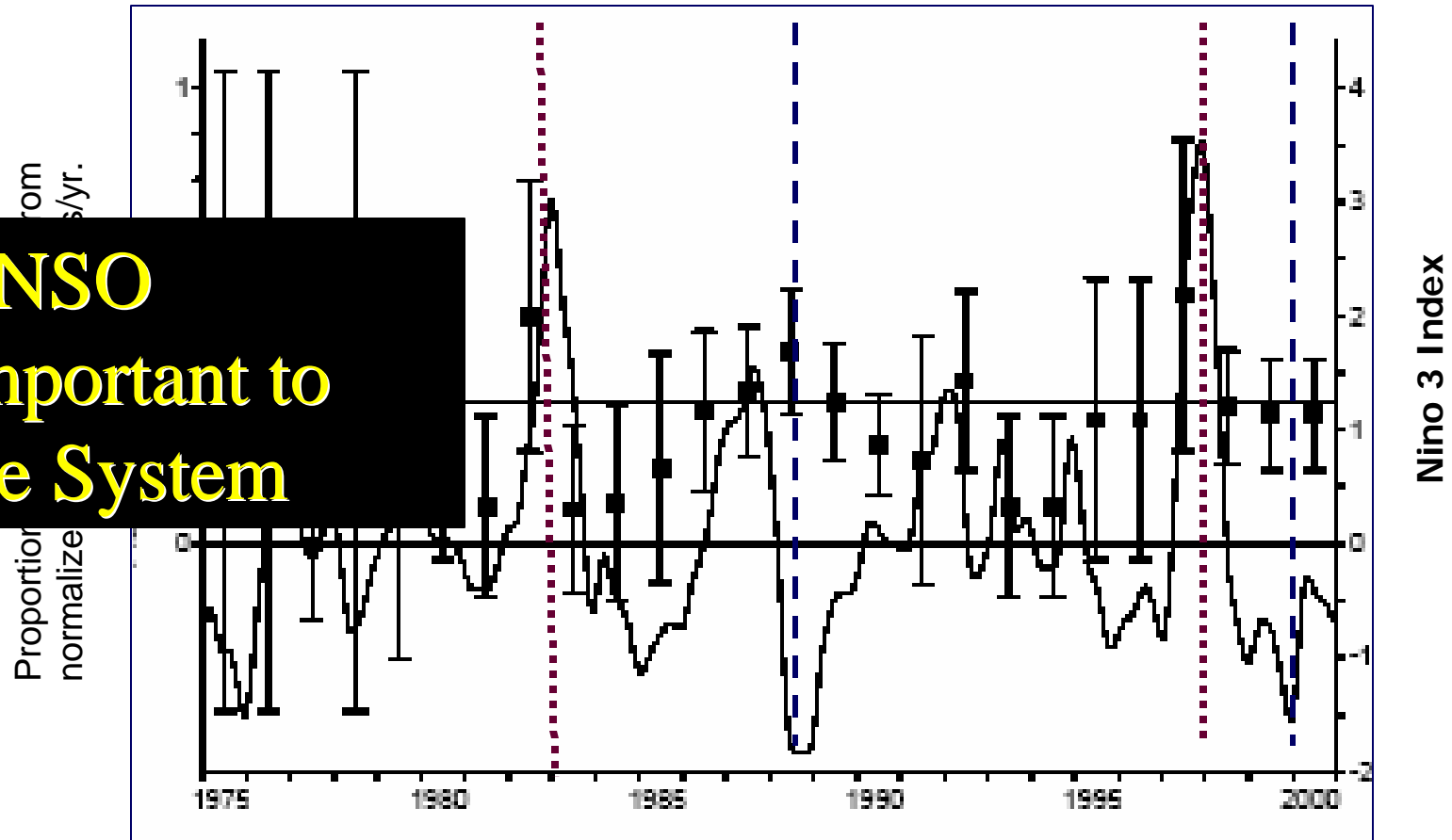
# Results – Abundance

- Seabirds and Cetaceans
  - k-selected
    - Year to year variability (sampling effects)
    - Few long-term trends



# Ecosystem Studies - Synthesis

➤ ENSO  
Important to  
the System





# What can ecosystem studies tell us about dolphin abundance trends?

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- ENSO-scale variability strong
- Little indication of trends (physical or biological)
- No support for ecosystem-caused lack of recovery
- BUT - Regime shifts evident with small physical effects in warm pool
  - Biological effects?



## Example 2: Ecosystem Studies Allow for Prediction in Unsampled Areas, at Fine Resolution

Ferguson et al., *In Press*

# The Issue

Marine Mammal Protection Act, Endangered Species Act, National Environmental Policy Act require users of the marine environment to conduct environmental assessments regarding impact of activities on marine mammals.

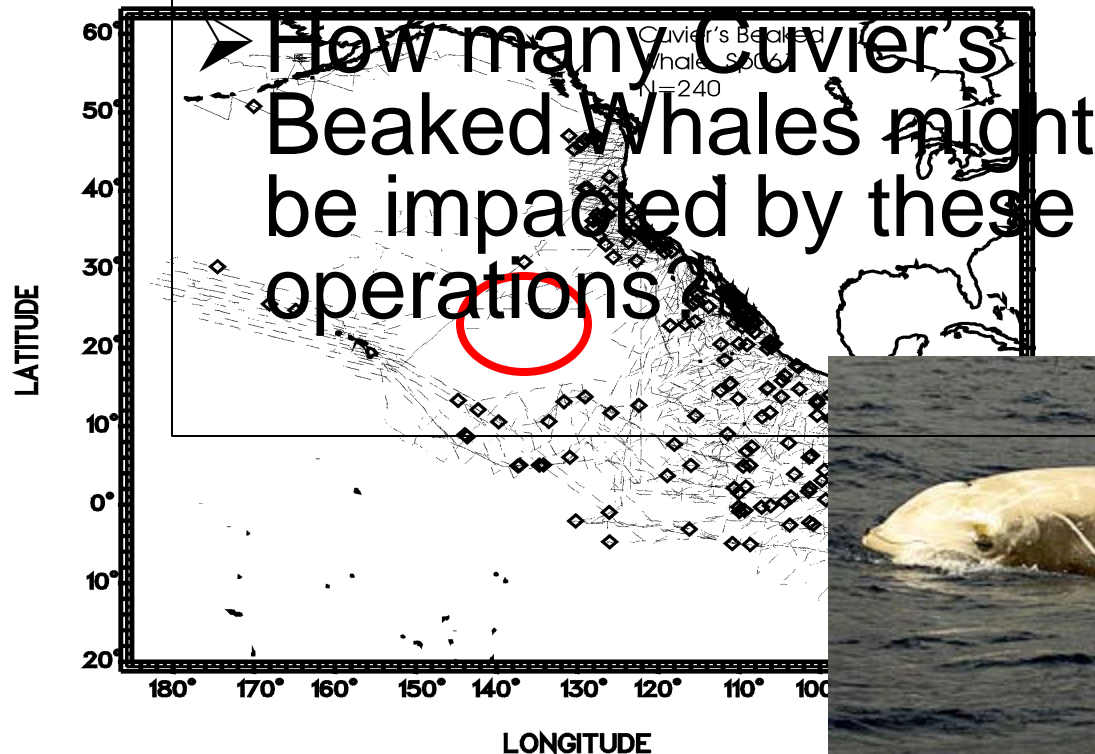
Example: Naval operations on the high seas – potential impacts on beaked whales

Cuvier's beaked whale density estimates available for "eastern tropical Pacific"

No sightings, little data in area of interest!

*The Question:*  
**How Many?**

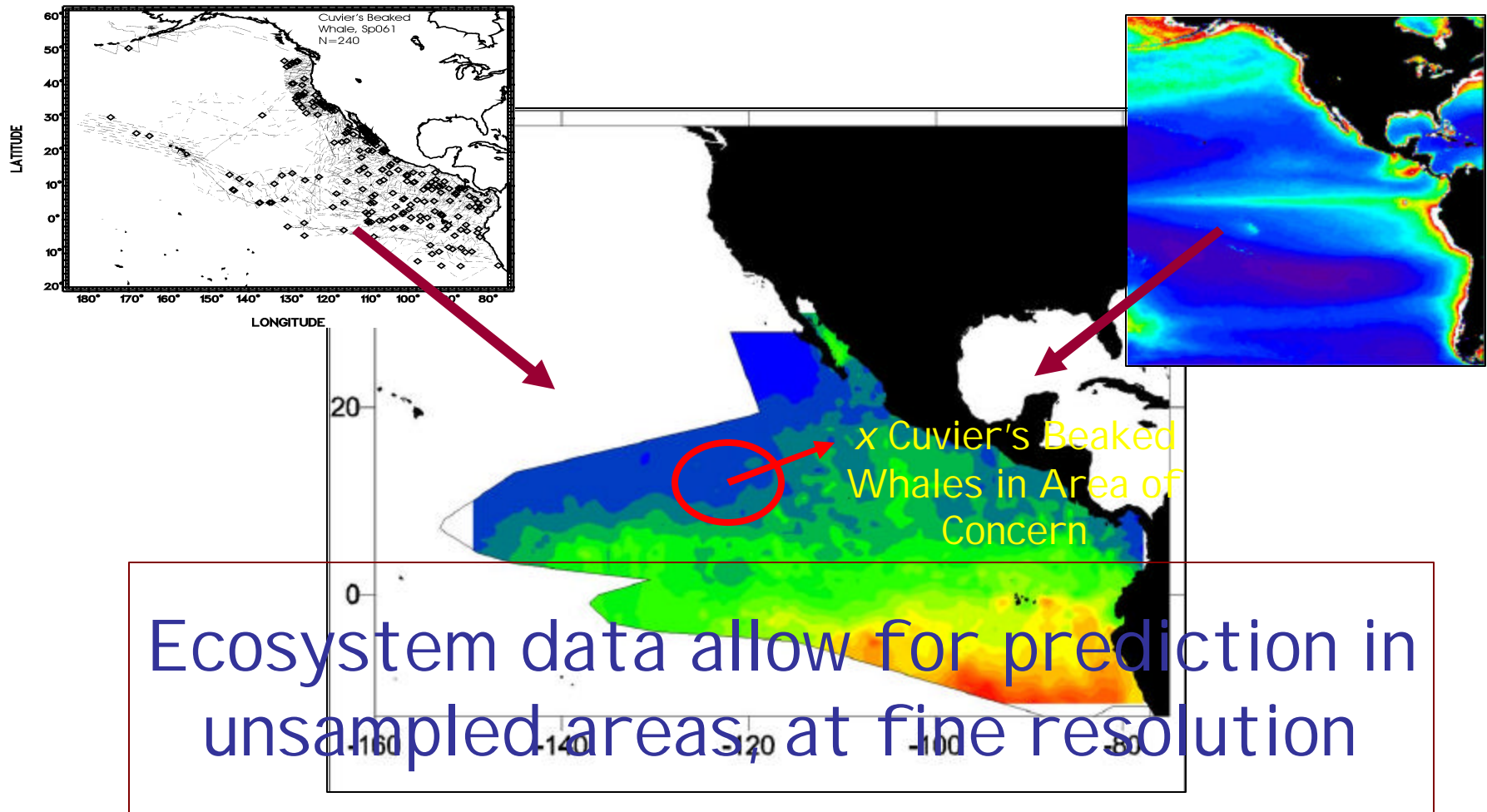
*The Problem:*  
**Numbers are either unavailable or based on different geographic areas.**



# Using Ecosystem Data to Answer the Question

Cuvier's Beaked Whale Sightings

Physical and Biological Habitat





*Conceptual*

Example 3: Ecosystem Studies Provide  
Data to Develop Ecosystem  
Approaches to Management

The challenge of ecosystem based management is to look beyond how actions affect single species so as to identify relationships among ecosystem components.

# Relationships between ecosystem components are often indirect and result in cascading effects

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- Temperate North Pacific Continental Shelf
    - ? sea otters = ? sea urchins = ? kelp = ? community diversity
  - Southern Ocean
    - ? baleen whales = ? krill = ? penguins, fur seals (?)
  - Eastern Tropical Pacific
    - ? yellowfin tuna = ? flyingfishes and squids = ? seabirds (!)
- Unintended Consequences**
- +**



1. No action occurs in a vacuum
  2. There is uncertainty in how ecosystems function
- We cannot reduce this uncertainty unless we combine sophisticated analytical and modeling methods with comprehensive ecosystem data – *ecosystem modelers extraordinaire*, 2006

- Ecosystem data provide the potential to identify relationships among ecosystem components (unintended consequences).
- Knowledge regarding tradeoffs allows for informed management decisions.
- Ecosystem-based management!



# Ecosystem Approach to Management: Conclusions



## Research Goals

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1. Identify significant habitat relationships
2. Understand effects of ecosystem variation
3. Identify relationships among ecosystem components
4. Develop models to attempt forecasting *and quantify their uncertainty*
5. Provide ecosystem data (no data = no EAM)



# Lessons

1. The significance of spatial and temporal scale decisions
2. Comprehensive data (with constant reassessment)
  - Partner with centers of excellence
3. Remote Sensing vs. Contemporaneous Sampling
  - Direct Matches in Space and Time
  - Water column properties
  - Mid-trophics!
4. Data Management
  - Internal infrastructure critical
5. Reductionism – how far?

Of Note: Since 2001, the vast majority of ecosystem research conducted by PRD, SWFSC has been supported by non-NOAA funds (US Navy and other), including research in eastern and central tropical Pacific, and California Current.